Preliminary Results of the GOES-R Post-Launch Airborne Science Field Campaign

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Introduction

The GOES-R post-launch airborne science field campaign was developed to support post-launch validation of L1b & L2+ products of the Advanced Baseline Imager (ABI) & Geostationary Lightning Mapper (GLM). The GOES-R field campaign has an open data policy for any researcher, faculty or student wishing to use the data collected during this effort. The campaign totaled 105.1 mission flight hours (16 validation missions) conducted from March 21 to May 17, 2017.

ABI Field Campaign Objectives

- **Primary Objective:** provide validation of ABI L1b spectral radiance observations to validate SI traceability
- **Secondary objective:** provide surface and atmospheric geo-physical measurements to support L1b & L2+ product validation

GLM Field Campaign Objectives

- **Primary Objective:** provide validation of GLM flash detection efficiency day through night over land at well characterized total lightning supersites: Northern AL, Norman OK, Lubbock TX, KSC FL, and Wallops/DC area, as well as other LMAs
- **Secondary Objective:** provide validation of GLM flash detection efficiency day through night at other land locations and over ocean
- **Tertiary Objective:** provide validation of GLM flash location & time stamp accuracy, and GLM image navigation & registration accuracy

GOES-R Field Campaign Lifecycle

Preparation

Defining validation objectives, priorities and, technical approach working with the GOES-R Calibration Working Group (CWG) and Algorithm Working Group (AWG) science teams.

Execution

Two phased approach:

- **Phase 1 – PMD:** Palmdale, CA

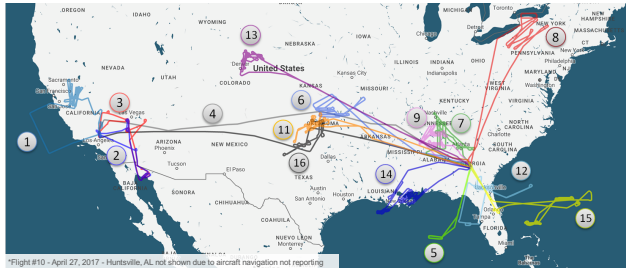
  March 21 – April 10, 2017
- **Phase 2 – WRB:** Warner Robins, GA

  April 11 – May 17, 2017

Analysis

Data analysis supports provisional & full maturity validation of ABI & GLM. The field campaign data sets will be used by a number of science teams in developing Golden Days where multiple science teams can assess product precedence impacts in the their provisional algorithm assessments.

GOES-R Field Campaign Flights



*Flight #10 - April 27, 2017 - Huntsville, AL not shown due to aircraft navigation not reporting

ER-2 Altitude Aircraft Based Instruments

Phase I: Mission operations from PMD (March 12-29, 2017) -- ABI Primary Missions

1) **March 21, 2017 (6.6 hr mission)** – Test flight/Science mission - Calibration maneuvers conducted for instrument checkout in addition to a GLM validation mission that resulted in the continuous observation of an active line of thunderstorms (NWS severe thunderstorm warnings issued with damaging surface winds reported) east of San Francisco.

2-3) **March 23, 2017 (5.7 hr mission) & March 28, 2017 (6.4 hr mission)** – Completed ABI primary Reflective Solar Band (RSB) validation objectives (2 sorties): The fully coordinated validation mission set required a diplomatic flight clearance with the Mexican government, aircraft special maneuvers, ABI special scans, and coordinated ground validation teams. These two collections & data sets are unprecedented in geostationary Earth observation and are a major achievement towards the post-validation of the next generation of GOES imagers.

Phase 2: Mission operations from WRB (April 16 - May 17, 2017) -- GLM Primary Missions

❖ All GLM missions conducted with ABI 30-second imagery concurrent with the ER-2 aircraft

5) **April 13, 2017 (3.9 hr mission)** – Completed ABI primary Thermal Emissive Band (TEB) validation objectives – the validation mission set required targeted aircraft maneuvers and ABI special scans at night over the Gulf of Mexico.

8) **April 20-21, 2017** (7 hr mission) – Targeted northern latitude lightning over the Toronto LMA from a line of organized storms that produced horizontally extensive and high flash rate lightning observed during the transition from twilight to night conditions.

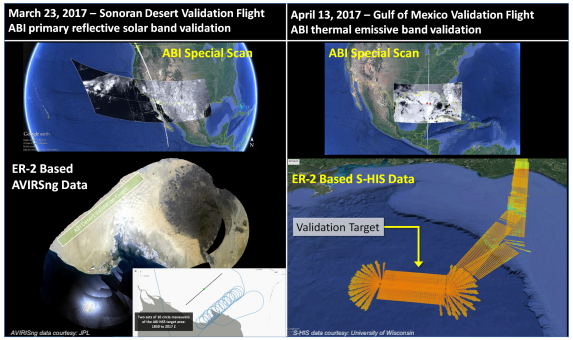
12) **May 7, 2017** (5.4 hr mission) – Collected the West Mims wildfire along the FL/GA border and extensive plume from the source region over land to 250 nautical miles east into the Atlantic. Conducted coincident and collocated collections with Landsat 8 & S-NPP satellites. A Terra MODIS overpass of the fire region was also observed that will compliment validation data analysis of L2+ products.

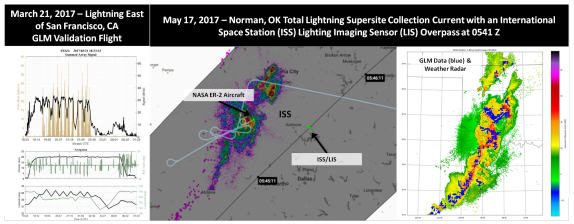
16) **May 16-17, 2017** (7.8 hr mission) – Collected 3 hours of a variety of compact & horizontally extensive high flash rate lightning producing storms co-located with the Oklahoma & West Texas total lightning supersites at night. A coincident and co-located ISS/LIS overpass was collected over an active line of high flash rate thunderstorms near the Southern Oklahoma/Northern Texas border. The aircraft continued westward following the lightning collections to transit the aircraft back to NASA Armstrong (PMD) completing the campaign.

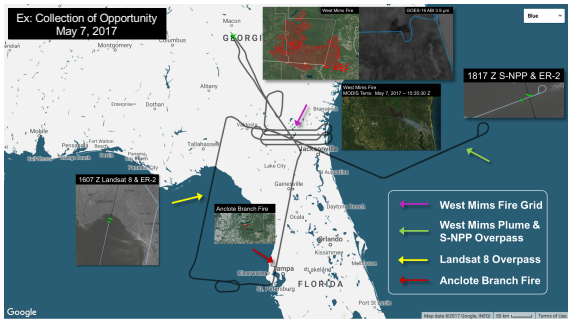
ER-2 Altitude Aircraft Based Instruments

Instrument		Type	Spectral Range	Spectral Res.	GSD	FOV	Swath Width
Phase 1	AVIRISng	Hyperspectral	380 – 2510 nm	5 nm	0.3 to 20 m	34 deg	~11 km
Phase 2	AVIRISc	Hyperspectral	400– 2500 nm	10 nm	1.5 m	34 deg	~11 km
S-HIS		Hyperspectral	3.3 - 18 µm	0.5 cm^{-1}	2 km	40 deg	40 km
FEGS		Passive EO	near-IR (777.4 nm)	10 nm			~10 km
LIP		Passive Electrical					
CPL		Lidar	1064, 532, & 355 nm		30x200 m		
CRS		Doppler Radar	94 GHz (W-band; 3 mm wavelength)		na		
EXRAD		Doppler Radar	9.6 GHz X-band		1.2 km		
GCAS		Hyperspectral	300-490 nm 480-900 nm	0.6 nm; 2.8 nm	350x1000m 250x250m	45 deg; 70 deg	

Preliminary Results







Conclusion

- The ER-2 validation missions included flights over ideal vicarious earth targets (desert and ocean sites), thunderstorm overflights over total lightning reference data supersites and ocean (39.5 hours of collection: 21 hours day, 15 hours night, and 3.5 hours twilight), active wildfires, and an expansive set of cloud and moisture phenomenology.
- The GOES-R field campaign provided significant reference data in support of the objective to ensure the post-launch data quality of NOAA's new era of operational environmental geostationary satellites to our users.